TECHNICAL REPORT
FISHERIES AND AQUATIC RESOURCES
CROSS CASCADE PIPELINE PROJECT

1.0 INTRODUCTION

This report summarizes the fishery and aquatic resources that may be affected by the construction, operation, and maintenance of the Cross Cascade Pipeline. The study area for this report encompasses all streams, rivers, lakes, and creeks along, and downstream of, the proposed pipeline route. The pipeline crossings and the waterways are shown in Appendix A.

Most of the information in this report was directly taken from the original EFSEC Application prepared and submitted by Dames & Moore (Dames & Moore, 1996a) on February 5, 1996. The Jones & Stokes EIS Comments (Jones & Stokes, 1996) on Fisheries and Aquatic Resources are addressed in the following pages. This report incorporates new information gathered since the EFSEC Application submittal.

The focus of this fisheries investigation is on salmonids (salmon and trout) because of their economic, cultural, and biological importance. Most of the potential impacts of this project to aquatic resources also emphasize salmonids. These species have a well-documented sensitivity to a wide range of environmental stresses and are located near the top of the aquatic food chain. Streams which support anadromous salmon or trout species are further emphasized in this report.

1.1 METHODS

Numerous data sources were reviewed for fisheries information to prepare the original EFSEC Application and this report. Information from the United States Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), Washington Department of Fish and Wildlife (WDFW), and Washington Department of Natural Resources (WDNR) was reviewed. Databases from the old Washington Department of Fisheries (WDF) stream catalog (Williams et al., 1975), the Washington Rivers Information System (WARIS: WDFW, 1995a), Washington Department of Natural Resources Data96, and the Pacific States Marine Fisheries Association (PSMFA, 1995) were also analyzed to obtain information on fish utilization, distribution, and other data.

Much of the survey procedure in Dames & Moore (1996a) was based on the WARIS information (WDFW, 1995a). This database, developed by WDFW, is the standard database for fisheries information. For Dames & Moore (1996a), all of the data sources were used to identify the waterways that would be crossed by the proposed pipeline and the aquatic resources at, and downstream, of each crossing. The databases were also used for information on sensitive species, hydrology, and other items.

Initial field surveys were performed during August, 1995, and focused primarily on the potential waterway crossing locations to determine the presence and types of fisheries habitat areas. For each large stream crossing that had surface flow, two field forms were filled out. General field notes were recorded for other waterways. Habitat characteristics were recorded on one form, and channel stability data were recorded on the other. See Appendix B for the field forms. The field forms were modified from EPA Rapid Bioassessment Protocols (EPA, 1989) for evaluating fish and habitat conditions.

The WARIS data indicated that there were approximately 156 waterways that would be crossed by the pipeline. During field surveys in August, 1995, Dames & Moore also identified seven additional waterways and they were inventoried. All of the waterways (163 total) were mapped in the EFSEC Application Map Atlas (Appendix A of Dames & Moore, 1996a).

The initial fisheries surveys focused on the larger, named waterways. The surveys focused on the waterways that had potential fishery resources at the pipeline crossing locations, or the streams that could directly affect downstream reaches. Less important streams, like the numerous irrigation canals along the eastern portion of the pipeline alignment, were not surveyed. Accordingly, the potential project impacts to the fishery resources were based on this small number of waterway crossings.

In the Fisheries and Aquatic Resources Section (3.4.4) of the EFSEC Application (Dames & Moore, 1996a), 99 specific waterway crossings were evaluated for their fisheries utilization, salmonid habitat, and potential impact area. These crossings included all of the major streams along the pipeline route indicated by WARIS (WDFW, 1995a), and the seven additional streams that were located during the field surveys.

After the fisheries surveys were completed and the EFSEC Application submitted, the WARIS information was more thoroughly reviewed. Several problems were identified in the database. The WARIS data are based on 1:100,000 scale maps and many project waterway crossings were not included. Also, fisheries and hydrology data were not available for the many of the project streams.

This report incorporates the regulatory agencies' comments on the EFSEC Application (Jones & Stokes, 1996), especially in regard to the need for a more complete inventory of the project streams. To address this, Dames & Moore obtained another database (Data96) from the Washington Department of Natural Resources. The database is based on 1:24,000 scale hydrography with some photogrammatic interpretation, and all channels with a defined bed and bank were identified. Even though the database does not have information on fishery resources, it identified all potential waterways that may be crossed by the pipeline. Many of these waterways have not been field-verified by DNR or Dames & Moore but they were used as the basis for this report.

Additional fisheries field surveys were conducted from March to July, 1996, to inventory more waterways. Most irrigation canal crossings and many small waterways along the pipeline route were surveyed. Not all waterways identified in Data 96 have been surveyed, but data have been collected on the important project streams.

1.2 PIPELINE ALIGNMENT

The proposed pipeline route was chosen to minimize the total lineal length and to avoid critical habitat and stream crossings. Even though there are many stream crossings, the route follows existing transmission line corridors, roads, and railroad grades where possible. These corridors are ideal for constructing the pipeline because impacts can be confined in already affected areas. The transmission line corridors have been cleared of large trees and few mature trees would be damaged at the stream crossings. These areas also have good heavy equipment access via the numerous roads that follow the corridor.

Many pipeline crossings will occur at existing road or railroad grade crossings and these crossings currently have culverts which will ease construction. The fill on top of the culverts is often deep and will allow pipeline placement without disturbance of the stream channel.

Existing bridges will also be utilized for four crossings to minimize project impacts. The Snoqualmie River near Duvall and Snoqualmie, Washington (Table 3; Crossing Numbers 11 and 38), and the South Fork (S.F.) Snoqualmie River near North Bend, Washington (Crossing Numbers 18 and 19), would be crossed with bridges. No instream habitat would be affected at those locations.

Near Snoqualmie Pass, the pipeline will follow the John Wayne Trail, and impacts to aquatic resources will be minimized. Most waterway crossings along the trail have culverts and deep road fills above the culverts. Trenching will occur in the fill and the channels will not be impacted.

Much of the pipeline route will be located east of the Cascade Mountains. Between Kittitas/Ellensburg and Pasco, Washington, the pipeline route frequently follows named roads and crosses pasture and agricultural land. Many of the creeks crossed by the pipeline drain flood-irrigated pasturelands and are intermingled with numerous irrigation canal/ditches. Many of the streams are heavily channelized, frequently culverted, and regularly excavated. These streams are managed primarily for water conveyance. Some of the waterways do currently support fish resources, but most have low fisheries production. Therefore, fisheries impacts of the project will be minimal for these waterways

2.0 EXISTING ENVIRONMENT

The study area lies mainly within the Snoqualmie, S.F. Snoqualmie, Yakima, and middle Columbia River basins. Some project streams in the western portion of the pipeline alignment are in the Sammamish and Snohomish River basins.

Construction of the Cross Cascade Pipeline could potentially result in approximately 285 crossings of rivers, streams, and irrigation canals identified from the DNR database. The largest water bodies in the corridor are the Snoqualmie River, S.F. Snoqualmie River, Yakima River, and the Columbia River. The pipeline would also cross many smaller streams that have important fisheries values, including Cherry Creek, Tolt River, Griffin Creek, and Tokul Creek.

Many of the streams, rivers, and canals that would be crossed by the pipeline support anadromous and resident salmonids, warmwater game fish, and nongame species. Important salmon species found in the project area include chinook, coho, pink, chum, and sockeye salmon. Table 1 lists all of the fish species that are likely to utilize the habitat of the water bodies at the pipeline crossings, and consequently may be affected by the project (WDFW, 1995a).

TABLE 1
FISH THAT OCCUR IN THE STUDY AREA[a]

Common Name	Scientific Name
Anadromous Fish	
Chinook Salmon	*Oncorhynchus tshawytscha*
Chum Salmon	*Oncorhynchus keta*
Coho Salmon	*Oncorhynchus kisutch*
Pink Salmon	*Oncorhynchus gorbuscha*
Sockeye Salmon	*Oncorhynchus nerka*
Cutthroat Trout (Sea-run)	*Oncorhynchus clarki*
Steelhead Trout	*Oncorhynchus mykiss*
Dolly Varden	*Salvelinus malma*
Pacific Lamprey	*Lampetra tridentata*
Resident Salmonids	
Rainbow Trout	*Oncorhynchus mykiss*
Westslope Cutthroat Trout	*Oncorhynchus clarki lewisi*
Bull Trout	*Salvelinus confluentis*
Other Species	
Mountain Whitefish	*Prosopium williamsoni*
Largescale Sucker	*Catostomus macrocheilus*
Sculpins (General)	*Cottus sp.*
Northern Squawfish	*Ptychocheilus oregonensis*
Speckled Dace	*Rhinichthys osculus*
Longnose Dace	*Rhinichthys cataractae*
Bridgelip Sucker	*Catostomus columbianus*
Yellow Perch	*Perca flavescens*
Walleye	*Stizostedion vitreum*

TABLE 1 (CONTINUED)
FISH THAT OCCUR IN THE STUDY AREA[(a)]

Common Name	Scientific Name
Largemouth Bass	*Micropterus salmoides*
Smallmouth Bass	*Micropterus dolomieui*
Brown Bullhead	*Ictalurus nebulosus*
Pumpkinseed	*Lepomis gibbosus*
Carp	*Cyprinus carpio*
Black Crappie	*Pomoxis nigromaculatus*
Western Brook Lamprey	*Lampetra richardsoni*

(a) From WARIS (WDFW, 1995a)

2.1 THREATENED, ENDANGERED AND SENSITIVE FISH SPECIES

The U.S. Fish and Wildlife Service, National Marine Fisheries Service, and Washington Department of Fish and Wildlife were contacted for information on threatened and endangered fish species that occur in the study area.

There are no federal or state listed threatened or endangered species that utilize the streams and rivers of the project area. Species of concern may be present in some of the project streams crossed by the proposed pipeline. These species are listed in Table 2.

TABLE 2
SENSITIVE FISH SPECIES LIKELY TO OCCUR IN THE STUDY AREA

Common Name	Scientific Name	Federal Status[(a)]
Chinook Salmon (all stocks)	*Oncorhynchus tshawytscha*	FC
Coho Salmon (all stocks)	*Oncorhynchus kisutch*	FC
Pink Salmon (all stocks)	*Oncorhynchus gorbuscha*	FC
Chum Salmon (all stocks)	*Oncorhynchus keta*	FC
Sockeye Salmon (all stocks)	*Oncorhynchus nerka*	FC
Sea-run Cutthroat Trout (all stocks)	*Oncorhynchus clarki*	FC
Steelhead (all stocks)	*Oncorhynchus mykiss*	FC
Bull Trout	*Salvelinus confluentas*	FC
Dolly Varden	*Salvelinus malma*	FC
Green sturgeon	*Acipenser medirostris*	FC

River Lamprey	*Lampetra ayresi*	FC
Pacific Lamprey	*Lampetra tridentata*	FC
Westslope Cutthroat Trout	*Oncorhynchus clarki lewisi*	FC

The State of Washington has identified several important Priority Species that utilize streams in the project area (WDFW, 1995b). While they do not currently have special status (State Monitor, State Candidate, etc.), they are important recreational and/or commercial species that are vulnerable to habitat loss or degradation. The species include:

- Sea-run cutthroat trout
- Steelhead trout
- Dolly Varden
- Rainbow trout
- Westslope cutthroat trout
- Bull trout
- Largemouth bass
- Smallmouth bass

2.2 SALMONID STOCKS AND MIGRATIONS

Chinook Salmon

Two runs of chinook have formerly used the Snoqualmie River Basin. The current status of spring chinook remains disputed, however, and agencies are trying to re-establish the runs of the Snohomish River Basin (WDF et al., 1992a). Fall chinook's geographical distribution includes the Snoqualmie River and its tributaries. They spawn from mid-September through October. Adult escapement in the Snohomish Basin ranged from 900 to 2,600 from 1979-1991, and averaged 1,700 adults (Puget, 1994). The chinook salmon are a depressed native stock (WDF et al., 1993). Even though summer/fall chinook stocks in Puget Sound are stronger than spring stocks, escapements have fallen drastically in several rivers.

The upper Yakima Basin has a depressed native stock of spring chinook. The majority of spawning occurs in the mainstem Yakima River from Ellensburg to Easton Dam (WDF et al., 1993). Spawning occurs between August and October. Escapement is low and redd counts have ranged from 2 to 35 redds/mile (1967-1991) (WDF et al., 1993).

Coho Salmon

Coho salmon use virtually every accessible stream in the Snoqualmie Basin but escapement is unknown. Coho spawn from early November through late January or mid-February. The stock is considered healthy

(WDF et al., 1993) and is comprised of hatchery and wild fish. Juvenile coho characteristically stay in freshwater more than a year and migrate seaward from mid-April to mid-July.

Chum Salmon

Chum salmon escapement in the Skykomish Basin was 3,600 to 44,000 for odd-year fish (1969-1991) and 10,000 to 67,000 for even-year fish (1968-1990) (WDF et al., 1993). Specific escapement information is lacking for the Snohomish River Basin. Adult chum have been observed in a side channel of the Snoqualmie River near Fall City, and in the Tolt River (WDF et al., 1992b). The spawning period is from mid-November through December. Relatively little spawning activity occurs in tributaries to the Snoqualmie River. Fry emerge from redds in March and April and quickly begin their seaward migration. The majority of each year-class leave freshwater by mid-June (Williams et al., 1975).

Pink Salmon

The odd-year escapement of pink salmon in the Snohomish Basin is large and has ranged from 70,000 to 302,000 (1967-1991) (WDF et al., 1993). Escapement of even-year fish ranged from 140 to 2,200 fish (1980-1990) (WDF et al., 1993). Both stocks are considered healthy. The Snoqualmie River supports an odd-year run of pink salmon, and mainstem spawning of even-year fish is suspected (WDF et al., 1993). Juvenile salmon begin migrating seaward quickly and complete their migration by late May (Williams et al., 1975).

Steelhead Trout

Steelhead trout are a highly prized sport fish in Washington. The Snoqualmie Basin supports summer and winter steelhead. A summer run utilizes the Tolt River but this stock is depressed (WDF et al., 1993). Snorkel counts have observed 20 to 30 wild adults (WDF et al., 1993). A healthy winter run steelhead stock exists in the Snoqualmie River, Tolt River, and other basin tributaries. Winter steelhead escapement ranged from 1,303 to 2,536 from 1982 through 1992 (Puget, 1994). Summer steelhead spawn from May through September (Withler, 1966) and winter run spawning occurs from November through April. Steelhead juveniles will remain in freshwater 1 to 3 years before migrating to the sea. The majority of steelhead juveniles in Washington reside in freshwater for 2 years (Puget, 1994).

The Yakima river has a native, wild stock of summer steelhead that is depressed due to irrigation diversions, drought conditions, habitat degradation, and juvenile and adult mortality associated with passage at four Columbia River hydroelectric dams (WDF et al., 1993). The Yakima River escapement has ranged from 64 to 2,198 fish (1980-1991) (WDF et al., 1991). There is also a distinct spawning population (winter run) that utilizes streams above Roza Dam. Spawning occurs from mid-February to late May.

Sea-Run Cutthroat Trout

Even though less abundant than steelhead trout, sea-run cutthroat are a major sport species in Washington. Spawning usually occurs from December to March, and most often in small tributaries. Fry emerge from redds between March and June, and smolts migrate between the second and sixth year of life. Peak outmigration is from March to May. Adults in the marine environment remain nearshore, often within 30 miles of their natal stream. Sea-run cutthroat have declined throughout their range.

Dolly Varden/Bull Trout

Historically, coastal native char were called Dolly Varden and inland native char were called bull trout. Dolly Varden migrate from the sea upriver (e.g., the Snohomish system) between May and December with spawning activity for both species in the late fall to mid-winter (October) (Scott and Crossman, 1973). Fry emerge in April and May and migrate to sea at age 3 or 4 in the spring. When in the salt water, Dolly Varden only migrate a short distance from their natal river. Bull trout spawn in gravel riffles in small streams with cold water. There is a long in-gravel development period compared with other salmonids and juveniles are closely associated with the stream bed.

Rainbow Trout

Rainbow trout are an important species in Washington and a principal sportfish above Snoqualmie Falls in the Snoqualmie River Watershed. Rainbow trout have a similar life history to steelhead. Spawning in the Snoqualmie Basin occurs from April to June with fry emerging in early to mid-summer. In the Yakima Drainage, rainbow trout generally spawn between February and June (Pearsons et al., 1992).

Cutthroat Trout

Cutthroat are abundant above Snoqualmie Falls in the upper Snoqualmie Basin. Cutthroat density was estimated at approximately 1,600 fish per mile in 1985 (Puget, 1991). A self-sustaining population probably occurs in the S.F. Snoqualmie River (Puget, 1994).

2.3 FISH HABITATS AND UTILIZATION

The DNR Data96 database indicated that there are 285 project waterways that could be crossed by the pipeline. Table 3 lists all project streams, their fisheries utilization, whether salmonid habitat is present, potential impact area, stream sensitivity index, and the proposed crossing methods. Of these, approximately 52 are classified as DNR Type 1, 2, or 3 waterways. These are the streams that are known to rear fish. Seventy two streams were classified as Type 4 or 5, and the remainder were not classified. See Water Technical Report (Dames & Moore, 1996b) for a listing of all classified streams.

The DNR Data96 waterways were mapped and are displayed in Appendix A. Data96 assumes that any channel identified from aerial photo interpretation is a waterway. Essentially all of the watercourses in the list of crossings have been or will be field-verified by Dames & Moore.

For this report, the fisheries resources and aquatic habitat are summarized for the larger project streams. Dames & Moore collected survey information and estimated potential impacts for 182 waterway crossings. All but one of the 103 unsurveyed waterways are first or second order streams. The pipeline crossing is usually located at the headwaters of these streams and these small channels probably have little fisheries habitat. It was assumed that pipeline crossings of these small waterways would affect primarily the water quality of downstream reaches. The sensitivity of these streams to construction, operation, and maintenance of the pipeline is addressed in the Water Technical Report (Dames & Moore, 1996b).

Descriptions of the specific areas of the pipeline crossings are provided, since those areas potentially would be impacted by the construction of the pipeline. The habitat characteristics of the project streams were developed for the EFSEC Application and from the field survey information (August 1995). Information on current fish utilization is primarily from WDFW (1995a), and supplemented by field observation data. The stream channel characteristics are frequently summarized by Rosgen channel types (Rosgen, 1993). Generalized stream type categories are described using broad descriptions of longitudinal profiles, valley and channel cross-sections, and plan-view patterns. Type A streams are steep (4 to 10 percent slope), with step, cascading, step/pool bed features. Type B streams are riffle-dominated types with "rapids" and infrequently spaced scour-pools at bends or areas of constriction. The C, DA, E and F streams are gentle-gradient riffle/pool types.

For simplicity, the fisheries resources are discussed by basin or subbasin and presented following the pipeline from west (near Woodinville) to east (Pasco, Washington).

Sammamish River Basin

Little Bear Creek is the only project stream that would be crossed by the pipeline that drains into the Sammamish River (S22,T27N,R5E). The proposed stream crossing site is under transmission lines and the stream is bordered by wetlands. The stream has a stable, low gradient B-channel and is dominated by cobble and rubble substrate. The dense riparian vegetation of alder, shrubs, and conifers have produced stable streambanks and the stream is in very good condition.

Little Bear Creek near the pipeline crossing is utilized by coho, chum, sockeye, chinook, cutthroat trout and sculpins (WDFW, 1995). The stream crossing site has spawning and summer rearing habitat for several of those species. This crossing will be by horizontal directional drilling, which will avoid impacts to both the stream and adjacent wetlands.

An unnamed tributary to Little Bear Creek (Crossing 4, see Table 3) would be crossed next to Highway 9. The crossing site is in the BPA transmission line corridor and has a failing culvert. The streambanks are dominated by blackberry, and recently several large cedars along the streambanks have been cut down. The small stream is utilized by coho salmon for spawning.

Snohomish River Basin

The headwaters of mainstem Anderson Creek and a tributary to Anderson Creek would be crossed by the proposed pipeline. The pipeline crossing site on Anderson Creek is located on the Echo Falls Golf Course and is heavily channelized (S20,T27N,R6E). Further downstream, the channel has many culverts and small waterfalls that were created when the golf course was built. During the survey, the creek was dry at the site and had no fisheries value.

Snoqualmie River Basin

For this report, the Snoqualmie Basin includes the area drained by the mainstem Snoqualmie River (and its tributaries) from its confluence with the Snohomish River to the S.F. Snoqualmie River. Within this basin, the Snoqualmie River and its tributaries can be divided into sections as discussed in the WDF stream catalog (Williams et al., 1975). They are described below.

Lower Mainstem Snoqualmie River

This section includes the lower 19.2 km (12 miles) of the Snoqualmie River and it tributaries, from a few kilometers above Duvall downstream to the confluence with the Skykomish River. The lower Snoqualmie River is a migration corridor for chinook, coho, pink, and chum salmon and steelhead (Williams et al., 1975). Only limited spawning habitat is available; however, Cherry and Peoples creeks support good to excellent spawning populations in their lower reaches.

The lower Snoqualmie River meanders through a broad valley floor that is bordered by small thickets of deciduous trees and shrubs. At the crossing location (S26,T27N,R6E), land use along the river is almost exclusively agricultural pasture land and the gradient is low (0.5 percent). This C-type channel had a bankfull discharge width of approximately 60 m and the stream substrate is all sand/silt. The lower river provides a transportation corridor for salmon and trout and has very little spawning habitat. Largescale suckers and sculpins have also been observed in the area. The slow-moving river lacks overhead or instream cover for salmonids and is warm during the summer months. Overall, the crossing area of the Snoqualmie River only provides rearing habitat for nongame species (Williams et al., 1975).

The pipeline would also cross the headwaters of Ricci and Peoples creeks. These small first and second order streams are characterized by small, incised B-type channels, moderate gradients, boulder and cobble substrates, and dense stands of riparian vegetation. These stable streams are lacking winter habitat for salmonids, but do have some summer rearing and patches of spawning gravel. The crossing sites for these streams are not accessible to anadromous salmonids.

In this subbasin, the pipeline would also cross three streams in the Cherry Creek basin. The unnamed tributary to North Fork Cherry Creek would be crossed twice. The stream at the upstream crossing is a moderately steep A/B-type channel with a baseflow of approximately 1 cfs. The small, stable stream is dominated by boulders and large rubble substrates and would favor resident salmonid usage. The dense vegetative canopy shades approximately 80 percent of the stream and is dominated by alder and various shrubs. The channel at the downstream crossing site is a much lower gradient (1.5 percent) B-type channel that is dominated by rubble and gravel substrates. This well-shaded stream segment has a bankfull width of approximately 3 m and does support anadromous salmonids. Juvenile coho salmon were observed during the site visit.

N.F. Cherry Creek was dry at the crossing site and has no fisheries values during the summer low flow period. Coho and pink salmon do utilize the lower portion of the creek. The crossing area is wetland and may provide some wintering habitat for salmonids during high precipitation months.

The mainstem Cherry Creek is an excellent stream with a good balance of pool-riffle-run habitat types. The B-type channel has a moderate gradient (2 percent) and overhead cover is provided primarily by mature alder trees in the fairly wide riparian zone. There is a good mixture of stream substrate sizes. Suitable spawning gravels were located high on dewatered gravel bars, which would favor winter-run steelhead trout usage. Other species which utilize the area include coho, pink, chinook, Pacific lamprey, and western brook lamprey. At the crossing site (S16,T26N,R7E), summer rearing habitat for anadromous salmonids was observed.

Middle Mainstem Snoqualmie River

This reach of the Snoqualmie River is transportation and rearing habitat for anadromous fish. Chinook, coho, chum, and pink salmon spawn and rear in the mainstem Snoqualmie near Carnation, Washington. Coho and chum also utilize Harris Creek, with chum spawning in the lower 1 km (Williams et al., 1975). Chinook, coho, chum and pink utilize the lower Tolt River, with chinook and coho ascending higher in the watershed.

Harris Creek and the Tolt River are the largest tributaries to the mainstem Snoqualmie River between Duvall and Carnation that will be crossed by the proposed pipeline.

At the pipeline crossing location (S27,T26N,R7E), Harris Creek is a low-gradient, meadow stream with a C-type channel. The stream is almost completely shaded by alder, dogwood, grasses, and other shrubs and meanders through wetland area. The stream substrate is almost entirely sand/silt and summer base flow was approximately 1.5 cfs. This small stream has summer and winter rearing habitat and is utilized by coho salmon, steelhead and cutthroat trout, and western brook lamprey.

The lower Tolt River is utilized by chinook, coho, chum, and pink salmon. Chum and pink are attracted to the channel splits and overflow channels in the lower river. Steelhead trout and western brook lamprey also utilize the area. At the proposed pipeline crossing location (S31,R8E,T26N), there are two distinct channels separated by an island. The RB (right bank facing downstream) has been riprapped to protect the county road and private residences during frequent flooding. The B-type channel is dominated by boulders and cobbles, but spawning gravel was observed on mid-stream bars. The river also has summer rearing habitat.

Upper Snoqualmie River

This section includes the mainstem Snoqualmie River and its tributaries from Carnation, Washington, to its confluence with S.F. Snoqualmie River. Several streams in the Griffin Creek subbasin, Tokul Creek, and the mainstem Snoqualmie River would be crossed by the proposed pipeline.

Chinook, coho, chum and pink salmon utilize the mainstem Snoqualmie within this section for transportation, spawning, and rearing (Williams et al., 1975). Chinook spawning is intense downstream of Fall City, Washington, and some pink and chum utilize this same area. Coho utilize mainly the tributaries, especially Griffin Creek. In Griffin Creek, the main spawning occurs between river miles 3.0 and 5.0.

Griffin Creek is a large tributary to the Snoqualmie River. The pipeline would cross the creek (S36,T25N,R73), where the main coho spawning in the stream occurs (river mile 4.3). The stream is a B-type channel with a moderate gradient. Stream substrate is predominantly gravel and rubble, and summer base flow was only approximately 1.5 cfs. The small stream had a bankfull width of about 15.5'. Unlike most project streams, Griffin Creek had a good amount of large woody debris (LWD) that provides excellent winter habitat for coho salmon and cutthroat trout. The good mixture of pool-riffle-run stream habitats also provides excellent summer and winter rearing habitat for fish.

The proposed pipeline would also cross the headwaters of several small tributaries to Griffin Creek and Tokul Creek. The crossing sites are in these tributary drainages and summer baseflow was less than 0.2 cfs. Two of the Griffin Creek tributaries have no fisheries value. The unnamed Tokul Creek tributaries are very steep, but may support resident trout.

At the pipeline crossing location (S17,T24N,R8E), Tokul Creek is a large stream with highly fluctuating flows and heavy bedload movement. The river has a moderate gradient, good pool-riffle-run balance, and suitable substrates for anadromous fish. However, a falls one mile upstream of the stream's mouth blocks migrations, and the habitat is utilized by cutthroat trout. Streambanks are moderately unstable and mature trees are falling into the stream channel. The riparian corridor overstory is dominated by alder and cedar trees. Stream substrate is primarily rubble and cobble, but some spawning habitat was observed. The stream also has summer and winter rearing habitat for resident salmonids. WDFW manages a fish hatchery near the mouth of Tokul Creek and their water intake is very vulnerable to water quality degradation.

The Snoqualmie River, approximately 2 kilometers above Snoqualmie Falls, would be crossed by the pipeline (S29,T24N,R8E). The low gradient (0.5 percent) C-type channel floods frequently. The stream substrate is entirely sand/silt and pool is the sole habitat type. The confined channel is riprapped on the left bank (LB) and bankfull width is approximately 132'. The stream provides limited summer rearing habitat for resident fish, primarily rainbow, cutthroat, and western brook lamprey.

The pipeline would follow the existing railroad grade across Meadowbrook Slough and two unnamed tributaries to the upper Snoqualmie river. The slough is an old, shallow oxbow of the Snoqualmie River and may support warmwater fish populations. The tributaries are very confined, channelized streams that had base flows of approximately 1 cfs. The streams were almost completely choked with grasses and alders and support a few cutthroat trout and sculpins.

South Fork Snoqualmie River

This section covers the entire S.F. Snoqualmie River and its tributaries that may be affected by the pipeline. There is no natural utilization of anadromous salmonids above Snoqualmie Falls, which is over 2.8 miles downstream from the South Fork.

The channel at the pipeline crossing location (S4,T23N,R8E) of the lower mainstem S.F. Snoqualmie River has a low gradient (0.5 percent). The relatively confined channel has been riprapped on left bank (LB-facing downstream), and follows a road prism on RB. Bankfull width is approximately 215'. The stream habitat is primarily pool. Gravel and sand/silt dominate the bottom substrates, with suitable patches of spawning gravel for resident salmonids located at the stream margins. Stream cover is low and consists mainly of intermittent stands of deciduous trees and underbrush. The small amount of instream cover is provided by the large riprap boulders. Resident trout were observed at the crossing site (August 28, 1995). Overall, the stream had a little spawning and summer rearing habitat for salmonids.

At the second crossing of S.F. Snoqualmie River (S14,T23N,R8E), the B-type channel is well confined by streambanks that are approximately 26' high. Bankfull width is about 110'. Stream gradient is 3.5 percent and the moderately steep channel is dominated by large boulders. This area has extremely high water velocities and the habitat is primarily riffle and run. The river has a little summer rearing habitat for resident salmonids.

After crossing the S.F. Snoqualmie River, the proposed pipeline route would follow the LB of the river and cross several named and unnamed tributaries. The following discussion of the existing conditions of the streams at the pipeline crossings is presented as the route goes upstream (easterly) toward Snoqualmie Pass.

Boxley Creek and one of its tributaries would be crossed approximately 0.8 mile upstream from the confluence with the S.F. Snoqualmie River. At the crossing location, the small unnamed tributary was dry when it was surveyed and had no fisheries value. The channel is dominated by gravel and rubble and may be used for spawning during higher winter/spring flows. The streambanks are very unstable and erosion of fine sediment is occurring. Boxley Creek is an excellent stream for resident salmonids. Stream habitat types are well-balanced and LWD has created good summer and winter rearing habitat for cutthroat trout. Stream substrate is predominantly gravel, but large amounts of sand/silt were also observed. This may be due to an unstable LB slide which would be a source of fine sediment.

Upstream of Boxley Creek, the pipeline route crosses several first and second order streams (named and unnamed) that drain generally northward to S.F. Snoqualmie River. These streams have very similar habitat characteristics at the proposed crossing locations.

Most of the unnamed tributaries are extremely small (less than 1 cfs). They are very steep drainages (7-10 percent) that provide little fisheries value. The named tributaries to the upper S.F. Snoqualmie River include Change, Hall, Mine, Alice, Carter, Hansen, Humpback, Olallie, and Rockdale Creeks. These streams were quite similar in habitat characteristics and factors limiting to fish production. Generally, the streams have steep (5 to 10 percent) A-type channels that are very unstable. Much of the upslope areas of these stream have experienced extensive logging that has resulted in high bedload movement and unstable streambanks. Bankfull width ranges from 20 to 30', and the streams are usually highly aggraded where the pipeline would cross. Stream substrate is dominated by large boulders and cobbles, and the summer base flows are very low or subsurface. Riffle is the dominant habitat type. During past surveys, only a few of the tributaries to upper S.F. Snoqualmie River had fish (WDFW, 1995). Several of the tributaries were dry during our survey and others provided little summer rearing habitat for salmonids. Winter rearing conditions (high streamflows) would be very restrictive to salmonids in these drainages.

Yakima River Basin

For the purposes of discussion, the Yakima River basin is divided into Upper Yakima River and Middle Yakima River. The creeks in the Kittitas/Ellensburg area (Middle Yakima River) drain irrigated pasturelands and are mixed with numerous irrigation canals and ditches. The creeks draining into the upper Yakima River, including those tributaries to Keechelus Lake, are more typical of channels draining forested hillsides.

Upper Yakima River

After crossing Snoqualmie Pass via the railroad tunnel, the proposed pipeline follows an existing railroad grade that crosses several tributaries on the west side of Keechelus Lake. Mill and Cold Creek have similar habitat characteristics. Both streams have concrete arch culverts that are passage barriers for resident fish. There is approximately 13' of fill on top of the culverts. The streams are B-type channels with a 2.5 percent gradient. Stream substrate in predominantly cobble, rubble, and boulder, with small patches of suitable spawning gravel for fish. Both streams have fairly heavy bedload movement under higher flows. Riffle is the dominant habitat type and the crossing areas have summer rearing habitat for salmonids. Under higher flows, fish would not be able to utilize these areas because of high water velocities and the lack of LWD which would create lower velocity winter habitat.

Roaring and Meadow Creeks are also tributaries to Keechelus Lake, and they provide more fisheries habitat than Mill and Cold Creeks. Their A/B-type channels have a good mix of habitat types, with riffle being dominant. Stream substrate favors rubble and cobble, but suitable spawning gravel is also present. The creeks are easily accessible from Keechelus Lake and fall spawning fish like bull trout could utilize the area. Overall, the stream crossing sites have summer and winter rearing habitat and fall and spring spawning habitat.

Mosquito Creek, Stampede Creek, and several unnamed tributaries between Stampede and Cabin Creeks, have little fisheries habitat at the proposed pipeline crossings. Mosquito Creek had no flow at the proposed pipeline crossing. Heavy bedload deposition has aggraded the featureless channel. Upstream of the railroad grade, Stampede Creek is mostly a marshy wetland and flow seeps through the railroad grade. The culvert is approximately 12' lower than the top of the grade and passes water only at high flows. The creek has little fisheries value. There are three unnamed tributaries that would be crossed by the pipeline. The small channels are well below the railroad grade and average 5' wide. They also have little fisheries habitat.

The pipeline will cross Cabin Creek at the abandoned railroad grade. At the crossing location (S9,T20N,R13E), Cabin Creek is a moderately stable low gradient B-type channel and is dominated by cobble/rubble substrates. The creek is downcutting and has a heavy bedload movement during high flows. The creek lacks woody debris and overhead cover. The streambanks are sparsely vegetated by cottonwood and alders, and most vegetation is above average bankfull width. Cobble/rubble substrates dominate the stream bottom. Mainstem Cabin Creek has summer rearing and marginal spawning habitat for resident salmonids.

The unnamed tributary to Cabin Creek flows out of an old beaver dam pond that is adjacent to the railroad grade, which is at the pipeline crossing location. The pond contains excellent habitat for fish. Floating and submerged woody debris, standing snags, and floating and emergent aquatic vegetation provide cover habitat for adult trout. The pond is surrounded by alder and conifer trees. The pond outlet follows the railroad grade, turns downstream under the Cabin Creek bridge, and enters Cabin Creek 200' downstream.

The pond and outlet creek provide summer and winter rearing habitat. The outlet creek would not be crossed by the pipeline.

At least four unnamed tributaries to the upper Yakima River between Cabin and Tucker Creeks will be crossed by the pipeline. These small first order streams have little fisheries value, but are contributors of high quality water to the Yakima River.

The pipeline will cross Tucker Creek in a powerline corridor. The creek is a moderately stable low gradient B-type channel and is dominated by gravel substrate. The creek is actively downcutting due to removal of woody debris and riparian vegetation. The stream flows through residential property that has been recently cleared. The water temperature was warm (63°F, August 1995). During normal years an upstream water user diverts the entire flow of the creek (per personal communication with landowner during field survey). There is spring spawning and limited summer rearing habitat at the crossing site.

The pipeline will also cross Main Canal twice, on either side of Tucker Creek. The large canal is straight and part of it is concrete lined. It has little fisheries value.

Big and Little Creeks will be crossed in a powerline corridor. At the crossing locations, both stream channels have been affected by the clearing of vegetation under the power transmission lines and the channels are actively moving laterally and downcutting. Big Creek has a larger basin and is characterized as a moderately stable low gradient B-channel that is dominated by rubble/cobble substrates. Little Creek is also moderately stable but has a flatter C-type channel. The streambanks are dominated by small alders, cottonwoods, willow and vine maples. Both streams are lacking large woody debris and instream cover is low. Young-of-year and juvenile salmonids were observed in both streams (August 30, 1995). Both creeks had spawning and summer rearing habitat.

Downstream of Little Creek, the proposed pipeline will cross several small tributaries under the transmission line corridor before it crosses the mainstem Yakima River. They are Granite, Peterson, Spec Arth, Tillman, and Thornton Creeks. These small creeks are first and second order streams and their streambeds are dominated by sand. Streambank vegetation is primarily grasses and emergent aquatic plants, with some small trees and shrubs. During the surveys, they either had low baseflow (< 1 cfs) or were dry. They had limited fisheries value but may provide some summer rearing habitat.

Where the pipeline will cross the Yakima River (S11,T19N,R16E), the bankfull width is approximately 200'. The well-confined channel was near bankfull during the field surveys. The B-type channel has a good mixture of stream substrates and is predominantly riffle habitat. Boulder, cobble and rubble substrates dominate the center of the channel. The stream margins have mainly rubble, gravel, and sand substrates. Streambanks are lined with willow, alder, and cottonwood. The Yakima River is an important spawning and rearing area for anadromous salmonids.

Middle Yakima River

The pipeline route runs along roads and across pastureland between Highway 97 and Kittitas. The creeks in the Kittitas/Ellensburg area drain flood-irrigated pasturelands and are intermingled with numerous irrigation canals/ditches. The creeks are heavily channelized, frequently culverted, regularly excavated, and generally were filled with turbid water. The riparian areas are very narrow to nonexistent. These creeks are managed primarily for water conveyance. Some of the creeks to be crossed have some fisheries value, despite the limitations noted.

Swauk Creek is a low gradient B-type channel dominated by gravel substrates. The valley bottom width is greater than 200'. The channel is unstable and shows signs of dramatic channel shifts and downcutting. The stream banks are heavily grazed by livestock. The channel lacks LWD and overhead cover. Sideslopes are steep, composed of sand/silt sediments, and sparsely vegetated. Numerous Cyprinids (unknown species) were observed at the crossing site.

The pipeline will cross four streams in the Dry Creek subbasin. Dry Creek has a moderately unstable B-type channel. The substrate is dominated by cobble/rubble particles. Willows and grasses dot the stream bank. The creek was dry during the survey and had no fisheries value.

Wilson and Naneum Creeks are in the best condition in this section of the Yakima River. Wilson Creek has a stable C-type channel. The substrate is cobble/rubble dominated. Grasses, cottonwoods, and willows provide relatively wide, stable riparian area in places. Grasses line moderately stable stream banks. One adult trout was observed at the crossing site. Naneum Creek and the unnamed tributary to Naneum Creek are cobble/rubble dominated, B-type channels. The grass lined streambanks were moderately stable and less impacted by excavation activities. The creek is lined by intermittently spaced willows and cottonwoods. Both streams had high water temperatures and limited summer rearing habitat for salmonids.

Park Creek, Coleman Creek, Schnebly Creek, Mercer Creek, Currier Creek, and Reecer Creek have very poor habitat for salmonids. These creeks are highly channelized with little riparian zone or overhead cover. The warm water ran turbid and near bankfull with irrigation water. These creeks have little fisheries value. They are managed for water conveyance.

Columbia River Basin

The mainstem Columbia River, Lower Crab Creek, an unnamed tributary to lower Crab Creek, and Johnson Creek are streams in this basin that drain into the Columbia River and would be crossed by the pipeline. The pipeline also crosses numerous irrigation canals and ditches (lined and unlined), two coulees, and a wasteway.

The Columbia River will be crossed just downstream of Wanapum Dam (S21,T16N,R23E). This area is influenced by dam discharges and the backwatering effects of Priest Rapids Lake. The streambanks are composed of rubble, cobble and gravel substrates and have little vegetation. Because of dam discharges, the stream habitat is primarily run and riffle. The crossing site probably provides spawning and summer rearing habitat for anadromous salmonids, especially fall run chinook salmon. Many other species of anadromous salmonids migrate past the crossing site.

Lower Crab Creek

The crossing sites on Lower Crab Creek and the unnamed tributaries are near the Columbia National Wildlife Refuge. The streams drain adjacent crop/rangeland and are managed for water conveyance. The channels are low gradient C types, dominated by sand substrate (assumed from streambank composition), and have little habitat diversity. The stream banks are dominated by grasses and are stable. The creek did not have much fisheries value. Johnson Creek drains arid grassland foothills and empties into the Columbia river through a private campground. Johnson Creek was dry at the survey site and construction during the low flow period would have little impacts to aquatic habitat. Within the campground the creek is heavily channelized and rip-rapped, was dominated by sand substrates, and had little fisheries value.

Irrigation Canals/Ditches

The pipeline route would cross many large and small irrigation canals. Some of the large waterways include Main, North Branch, Cascade, Highline, Royal Branch, Wahluke Branch, Eltopia Branch, and Esquatzel Diversion canals. Some of the canals are lined with concrete, especially when the crossing is near an existing road.

Approximately 44 irrigation canals/ditches will be crossed by the proposed pipeline and these waterways have limited salmonid value. The various canals, ditches, and coulees have supported yellow perch, black crappie, pumpkinseed, brown bullhead, largemouth bass, sculpin, bluegill, and a few resident trout. The straight, featureless channels have smooth bottoms and elevated water temperatures. Riparian vegetation along the canals is usually sparse, or non-existent. Canal maintenance probably prohibits the growth of riparian vegetation.

3.0 FISHERIES AND AQUATIC RESOURCES IMPACTS

This report summarizes the potential fishery impacts from physical disturbance of habitat and stormwater runoff at the specific waterway crossings. Other reports prepared by Dames & Moore address the additional potential impacts to the fishery resources that may result from the construction, operation, and maintenance of the pipeline. The Water Technical Report (Dames & Moore, 1996b) addresses the impacts to the downstream habitat and fisheries resources from sedimentation, especially spawning habitat. The potential impacts from the discharge of hydrostatic test water is discussed in Sections 2.5 (Water Supply System) and 2.7 (Aquatic Discharges) of the EFSEC Application.

In general, the primary potential impacts to fishery resources from pipeline installation and associated construction are from water quality degradation and physical alteration of instream and stream-adjacent habitat. Operation and maintenance activities should have no impacts on aquatic resources given the mitigation measures that will be incorporated into the operation phase of the project.

During construction, physical alterations may eliminate fisheries habitat and increase sedimentation and scouring of the streams. Project streams have a variety of habitats (summer rearing and winter rearing, spawning, and adult holding) for fish. Disturbance of the riparian vegetation adjacent to streams could increase suspended solids, turbidity and organic matter downstream from the construction areas. Stream crossings that require blasting can cause harm to fish due to acoustic shock or damage to their air bladders.

The impacts will be limited to the duration of, and immediately following, construction and will be minimized due to the incorporation of Best Management Practices for construction, operation, and maintenance of the pipeline. As described in Section 2.10 Surface Water Runoff (Dames & Moore, 1996), the construction contractors will implement an erosion and sediment control plan that includes Best Management Practice's environmental criteria (following (WAC 463-42-215)) to minimize environmental impacts. As noted in the EFSEC Application Section 3.4 Water, state water quality regulations (WAC 463-42-322) will be complied with during construction and operation of the pipeline.

The impact analysis on fishery and aquatic resources considered the potential for sedimentation and erosion, potential removal of vegetation, and the stream crossing methodologies, including whether blasting was likely to be needed.

3.1 STREAM CROSSING METHODOLOGIES

The actual impacts to the fish and aquatic habitat and resources will depend on the methodology selected for crossing the streams and the protective measures applied. The types of proposed crossing methods are flume and trench, divert and trench, dry trench, wet trench, existing fill crossing above or below a culvert, horizontal directional drilling, and using existing bridges to span the streams. Canals will generally be crossed by boring under them. The crossing methodologies are described in detail in Section 2.14 Construction Methodology of the EFSEC Application (Dames & Moore, 1996a).

The level of impacts is directly correlated to these crossings methods and other environmental variables (i.e., width of channel, angle of adjacent streambanks, presence of bedrock, access to sites, etc.). Table 3 lists major and minor project streams and the proposed crossing method for each.

TABLE 3
PIPELINE WATERWAY CROSSINGS, FISHERIES UTILIZATION, SALMONID HABITAT, POTENTIAL IMPACT AREA, SENSITIVITY INDEX, AND PROPOSED CROSSING METHODS

Waterway[1]	Tributary To[2]	Crossing Number[3]	Atlas Page[4]	Fisheries Utilization[5]				Salmonid Habitat[6]			Sensitivity Index			Crossing Type[7]
				Sens/ Anad	Res Sal	Other	Unk	Summer	Winter	Spawn	High	Mod	Low	
SNOHOMISH COUNTY														
Sammamish Basin														
Little Bear Creek (y)	Sammamish River	1	1	X	X	X		X		X	X			HDD
Unnamed (y)	Little Bear Creek	2	1				ND							F
Unnamed (y)	Little Bear Creek	3	1				ND							F
Unnamed (y)	Little Bear Creek	4	1	X						X	X			UC
Unnamed (y)	Little Bear Creek	5	2				ND							WET
Unnamed (n) (w)	Little Bear Creek	6	3											WET
Snohomish Basin														
Anderson Creek (y)	Snohomish River	7	3				X						X	UC
Unnamed (n) (w)	Anderson Creek	8	4											WET
Snoqualmie Basin														
Ricci Creek (y)	Snoqualmie River	9	4		X			X				X		D
Unnamed (u)	Snoqualmie River	10	4				ND							F
Unnamed (y)	Snoqualmie River	10A	5				ND							UC
Snoqualmie River (y)	Snohomish River	11	5	X							X			BRIDGE
Unnamed (u)		12	5				ND							Avoided
Unnamed (y)		13	5				ND							F

TABLE 3 (CONTINUED)
PIPELINE WATERWAY CROSSINGS, FISHERIES UTILIZATION, SALMONID HABITAT, POTENTIAL IMPACT AREA, SENSITIVITY INDEX, AND PROPOSED CROSSING METHODS

Waterway[1]	Tributary To[2]	Crossing Number[3]	Atlas Page[4]	Fisheries Utilization[5]				Salmonid Habitat[6]			Sensitivity Index			Crossing Type[7]
				Sens/ Anad	Res Sal	Other	Unk	Summer	Winter	Spawn	High	Mod	Low	
Peoples Creek (y)	Snoqualmie River	14	6		X			X				X		F
Peoples Creek (y)	Snoqualmie River	15	6		X			X				X		F
Unnamed (y)	Peoples Creek	16	6				X						X	OC
KING COUNTY **Snoqualmie Basin**														
Unnamed (y)	N.F. Cherry Creek	17	7		X			X				X		F
Unnamed (y)	N.F. Cherry Creek	18	7	X				X			X			F
N.F. Cherry Creek (y)	Cherry Creek	19	8				X		X				X	F or D
Cherry Creek (y)	Snoqualmie River	20	8	X				X	X	X	X			D or F
Unnamed (u)	Cherry Creek	21	8				ND							F
Harris Creek (y)	Snoqualmie River	22	9	X	X			X	X		X			F or D
Unnamed (y)	Harris Creek	23	9				ND							F
Unnamed (y)	Harris Creek	24	9				ND							F
Unnamed (u)	Harris Creek	25	10				ND							DRY
Tolt River (y)	Snoqualmie River	26	11	X				X		X	X			D
Tolt River (side channel) (y)	Snoqualmie River	27	11	X					X		X			D
Griffin Creek (y)	Snoqualmie River	28	12	X	X			X	X	X	X			D
Unnamed (u)	Griffin Creek	29	12				X						X	F or D

TABLE 3 (CONTINUED)
PIPELINE WATERWAY CROSSINGS, FISHERIES UTILIZATION, SALMONID HABITAT, POTENTIAL IMPACT AREA, SENSITIVITY INDEX, AND PROPOSED CROSSING METHODS

Waterway(1)	Tributary To(2)	Crossing Number(3)	Atlas Page(4)	Fisheries Utilization(5)				Salmonid Habitat(6)			Sensitivity Index			Crossing Type(7)
				Sens/ Anad	Res Sal	Other	Unk	Summer	Winter	Spawn	High	Mod	Low	
Unnamed (u)	Griffin Creek	30	12				X						X	F or D
Unnamed (y)	Griffin Creek	31	12				ND							F or D
Unnamed (y)	Tokul Creek	32	13		X			X					X	F
Unnamed (y)	Tokul Creek	33	14		X			X				X		Avoided
Tokul Creek (y)	Snoqualmie River	34	14		X			X	X	X		X		D
Unnamed (y)	Mill Pond	35	14		X			X		X		X		F
Unnamed (u)		36	14				ND							F
Unnamed (y)	Pond	36A	14				ND							F
Unnamed (y)	Pond	37	14				ND							F
Snoqualmie River (y)	Snohomish River	38	14		X			X	X	X		X		BRIDGE
Meadowbrook Slough (y)		39	15				X						X	BRIDGE
Unnamed (y)	S.F. Snoqualmie R.	40	15		X				X			X		BRIDGE
Unnamed (y)	S.F. Snoqualmie R.	41	15		X				X			X		BRIDGE
S.F. Snoqualmie R. (y)	Snoqualmie River	42	15		X			X				X		BRIDGE
S.F. Snoqualmie R. (y)	Snoqualmie River	43	17		X			X				X		BRIDGE
Boxley Creek (y)	S.F. Snoqualmie R.	44	17		X			X	X	X		X		F or D
Unnamed (y)	S.F. Snoqualmie R.	44A	17				ND							UC
Unnamed (y)	S.F. Snoqualmie R.	45	18				X			X			X	F

TABLE 3 (CONTINUED)
PIPELINE WATERWAY CROSSINGS, FISHERIES UTILIZATION, SALMONID HABITAT, POTENTIAL IMPACT AREA, SENSITIVITY INDEX, AND PROPOSED CROSSING METHODS

Waterway[1]	Tributary To[2]	Crossing Number[3]	Atlas Page[4]	Fisheries Utilization[5]				Salmonid Habitat[6]			Sensitivity Index			Crossing Type[7]
				Sens/ Anad	Res Sal	Other	Unk	Summer	Winter	Spawn	High	Mod	Low	
Unnamed (y)	S.F. Snoqualmie R.	46	18				X	X					X	OC
Unnamed (u)	S.F. Snoqualmie R.	47	18				ND							F or UC
Unnamed (u)	S.F. Snoqualmie R.	48	18				ND							F or UC
Unnamed (u)	S.F. Snoqualmie R.	49	18				ND							F or UC
Unnamed (u)	S.F. Snoqualmie R.	50	19				ND							F or UC
Unnamed (u)	S.F. Snoqualmie R.	51	19				ND							F or UC
Change Creek (y)	S.F. Snoqualmie R.	52	19				X						X	F or UC
Hall Creek (y)	S.F. Snoqualmie R.	53	19				X	X	X				X	F or UC
Unnamed (u)	S.F. Snoqualmie R.	54	19				ND							F or UC
Unnamed (u)	S.F. Snoqualmie R.	55	19				ND							F or UC
Unnamed (u)	S.F. Snoqualmie R.	56	19				ND							F or UC
Mine Creek (y)	S.F. Snoqualmie R.	57	19				X	X					X	F or UC
Unnamed (u)	S.F. Snoqualmie R.	58	20				ND							F or UC
Wood Creek (y)	S.F. Snoqualmie R.	59	20				X						X	F or UC
Alice Creek (y)	S.F. Snoqualmie R.	60	20				X						X	OC
Unnamed (u)	Unnamed Tributary	61	20				ND							F
Unnamed (u)	S.F. Snoqualmie R.	62	20				ND							F
Unnamed (u)	Unnamed Tributary	63	20				ND							F

TABLE 3 (CONTINUED)
PIPELINE WATERWAY CROSSINGS, FISHERIES UTILIZATION, SALMONID HABITAT, POTENTIAL IMPACT AREA, SENSITIVITY INDEX, AND PROPOSED CROSSING METHODS

Waterway[(1)]	Tributary To[(2)]	Crossing Number[(3)]	Atlas Page[(4)]	Fisheries Utilization[(5)]				Salmonid Habitat[(6)]			Sensitivity Index			Crossing Type[(7)]
				Sens/ Anad	Res Sal	Other	Unk	Summer	Winter	Spawn	High	Mod	Low	
Unnamed (u)	S.F. Snoqualmie R.	64	21				ND							F
Unnamed (u)		65	21				ND							F
Rock Creek (y)	S.F. Snoqualmie R.	66	21				X						X	D
Harris Creek (y)	S.F. Snoqualmie R.	67	21				X						X	D or BRIDGE
Unnamed (u)		68	21				ND							F or UC
Unnamed (u)		69	21				ND							F or UC
Unnamed (y)	S.F. Snoqualmie R.	70	21				X			X			X	F or UC
Unnamed (u)	S.F. Snoqualmie R.	71	21				X			X			X	F or UC
Carter Creek (y)	S.F. Snoqualmie R.	72	22				X	X					X	OC
Unnamed (y)	S.F. Snoqualmie R.	73	22				ND							F or UC
Unnamed (u)	S.F. Snoqualmie R.	74	22				ND							F or UC
Hansen Creek (y)	S.F. Snoqualmie R.	75	22		X			X				X		OC
Unnamed (u)	Pond	76	22				ND							F or UC
Unnamed (u)	S.F. Snoqualmie R.	77	22				X						X	F or UC
Humpback Creek (y)	S.F. Snoqualmie R.	78	23				X	X					X	D
Unnamed (n) (w)	S.F. Snoqualmie R.	79	23											WET
Unnamed (n) (w)	S.F. Snoqualmie R.	80	23											WET
Unnamed (n) (w)	S.F. Snoqualmie R.	81	23											WET

TABLE 3 (CONTINUED)
PIPELINE WATERWAY CROSSINGS, FISHERIES UTILIZATION, SALMONID HABITAT, POTENTIAL IMPACT AREA, SENSITIVITY INDEX, AND PROPOSED CROSSING METHODS

Waterway[1]	Tributary To[2]	Crossing Number[3]	Atlas Page[4]	Fisheries Utilization[5]				Salmonid Habitat[6]			Sensitivity Index			Crossing Type[7]
				Sens/ Anad	Res Sal	Other	Unk	Summer	Winter	Spawn	High	Mod	Low	
Unnamed (y)	S.F. Snoqualmie R.	82	24				ND							D
Olallie Creek (y)	S.F. Snoqualmie R.	83	24				X						X	D
Rockdale Creek (y)	S.F. Snoqualmie R.	84	24				X	X					X	D
KITTITAS COUNTY														
Yakima Basin														
Unnamed (y)	Keechelus Lake	85	25				ND							OC or UC
Mill Creek (y)	Keechelus Lake	86	26		X			X		X		X		OC or UC
Unnamed (y)	Keechelus Lake	87	26				X	X					X	OC or UC
Cold Creek (y)	Keechelus Lake	88	26				X	X		X			X	OC or UC
Unnamed (u)	Keechelus Lake	89	26				ND							OC or UC
Unnamed (u)	Keechelus Lake	90	26				ND							OC or UC
Unnamed (u)	Keechelus Lake	91	26				ND							OC or UC
Unnamed (y)	Keechelus Lake	92	26				ND							OC or UC
Unnamed (y)	Keechelus Lake	93	26				X						X	OC or UC
Unnamed (y)	Keechelus Lake	94	26				X						X	OC or UC
Unnamed (u)	Keechelus Lake	95	26				ND							OC or UC
Unnamed (y)	Keechelus Lake	96	27				ND							OC or UC
Roaring Creek (y)	Keechelus Lake	97	27				X	X	X	X		X		D or BRIDGE

TABLE 3 (CONTINUED)
PIPELINE WATERWAY CROSSINGS, FISHERIES UTILIZATION, SALMONID HABITAT, POTENTIAL IMPACT AREA, SENSITIVITY INDEX, AND PROPOSED CROSSING METHODS

Waterway[1]	Tributary To[2]	Crossing Number[3]	Atlas Page[4]	Fisheries Utilization[5]				Salmonid Habitat[6]			Sensitivity Index			Crossing Type[7]
				Sens/ Anad	Res Sal	Other	Unk	Summer	Winter	Spawn	High	Mod	Low	
Unnamed (u)	Keechelus Lake	98	27				ND							OC or UC
Meadow Creek (y)	Keechelus Lake	99	27				X	X	X	X		X		D or BRIDGE
Unnamed (u)	Pond	100	27				ND							OC or UC
Unnamed (u)	Yakima River	101	28				ND							OC or UC
Unnamed (u)	Yakima River	102	28				ND							OC or UC
Mosquito Creek (y)	Yakima River	103	28				X						X	OC or UC
Stampede Creek (y)	Yakima River	104	28				X	X					X	OC or UC
Unnamed (u)	Yakima River	105	29				X						X	OC or UC
Unnamed (u)	Yakima River	106	29				X	X					X	OC or UC
Unnamed (u)	Yakima River	107	29				ND							OC or UC
Unnamed (u)	Yakima River	108	30				X	X					X	OC or UC
Unnamed (u)	Yakima River	109	30				X	X					X	OC or UC
Unnamed (u)	Yakima River	110	30				ND							OC or UC
Unnamed (u)		111	30				ND							OC or UC
Unnamed (u)	Yakima River	112	30				X	X					X	OC or UC
Unnamed (u)		113	30				ND							OC or UC
Unnamed (u)		114	30				ND							OC or UC
Unnamed (u)	Yakima River	115	31				ND							OC or UC

TABLE 3 (CONTINUED)
PIPELINE WATERWAY CROSSINGS, FISHERIES UTILIZATION, SALMONID HABITAT, POTENTIAL IMPACT AREA, SENSITIVITY INDEX, AND PROPOSED CROSSING METHODS

Waterway(1)	Tributary To(2)	Crossing Number(3)	Atlas Page(4)	Fisheries Utilization(5)				Salmonid Habitat(6)			Sensitivity Index			Crossing Type(7)
				Sens/ Anad	Res Sal	Other	Unk	Summer	Winter	Spawn	High	Mod	Low	
Unnamed (u)	Yakima River	116	31				X						X	OC or UC
Cabin Creek (y)	Yakima River	117	31	X				X		X	X			D
Unnamed (u)	Pond	118	31				ND							D
Unnamed (u)	Pond	119	31				ND							D
Unnamed (u)		120	31				ND							D or F
Unnamed (u)	Lake Easton	121	32				ND							D or F
Unnamed (u)		122	32				ND							D or F
Main Canal (n) (c)		123	32				X						X	B
Tucker Creek (y)	Yakima River	124	33		X					X		X		F
Main Canal (n) (c)		125	33				X						X	B
Unnamed (u)	Big Creek	126	33				ND							F
Big Creek (y)	Yakima River	127	34	X				X		X	X			D or F
Unnamed (u)		128	34				ND							F
Little Creek (y)	Yakima River	129	34	X				X		X	X			F
Unnamed (u)		130	35				ND							F
Granite Creek (y)	Yakima River	131	35				X						X	F
Spex Arth Creek (y)	Yakima River	132	36		X			X				X		UC
Tillman Creek (y)	Yakima River	133	37				X						X	F

TABLE 3 (CONTINUED)
PIPELINE WATERWAY CROSSINGS, FISHERIES UTILIZATION, SALMONID HABITAT, POTENTIAL IMPACT AREA, SENSITIVITY INDEX, AND PROPOSED CROSSING METHODS

Waterway[1]	Tributary To[2]	Crossing Number[3]	Atlas Page[4]	Fisheries Utilization[5]				Salmonid Habitat[6]			Sensitivity Index			Crossing Type[7]
				Sens/ Anad	Res Sal	Other	Unk	Summer	Winter	Spawn	High	Mod	Low	
Unnamed (u)	Tillman Creek	134	37				ND							F
Unnamed (u)		135	38				ND							F
Unnamed (u)		136	38				ND							F
Unnamed (u)		137	39				ND							F
Unnamed (u)		138	39				ND							F
Unnamed (u)		139	39				ND							F
Unnamed (u)		140	39				ND							F
Unnamed (y)		141	40				ND							F
Unnamed (y)		142	40				ND							F
Thornton Creek (y)	Yakima River	143	40				X						X	D
Unnamed (y)		144	40				ND							F
Unnamed (u)		145	41				ND							F
Main Canal (n) (c)		146	41				X						X	B
Yakima River (y)	Columbia River	147	41	X	X			X		X	X			D or BRIDGE
Unnamed (n) (w)	Yakima River	148	42				ND							WET
Unnamed (u)	Pond	149	42				ND							DRY
Unnamed (u)	Swauk Creek	150	43				X						X	DRY
Swauk Creek (y)	Yakima River	151	43		X	X		X				X		F

TABLE 3 (CONTINUED)
PIPELINE WATERWAY CROSSINGS, FISHERIES UTILIZATION, SALMONID HABITAT, POTENTIAL IMPACT AREA, SENSITIVITY INDEX, AND PROPOSED CROSSING METHODS

Waterway[1]	Tributary To[2]	Crossing Number[3]	Atlas Page[4]	Fisheries Utilization[5]				Salmonid Habitat[6]			Sensitivity Index			Crossing Type[7]
				Sens/ Anad	Res Sal	Other	Unk	Summer	Winter	Spawn	High	Mod	Low	
Unnamed (n) (d)	Swauk Creek	152	43											DRY
Unnamed (n) (d)	Swauk Creek	153	43											DRY
Unnamed (y)	Dry	154	44				X						X	DRY
Unnamed (u)		155	44				ND							F
Dry Creek (y)	Yakima River	156	44			X							X	DRY
Dry Creek (y)	Yakima River	157	45			X							X	DRY
Unnamed (u)	Dry Creek	158	45				ND							DRY
Unnamed (u)	Dry Creek	159	45				ND							F
Dry Creek (u)	Yakima River	160	45			X							X	F
Dry Creek (y)	Yakima River	161	45			X							X	F
Unnamed (y)	Yakima River	162	45				X						X	F
Unnamed (y)		163	46				ND							F
Unnamed (y)	Yakima River	164	46				X						X	F
Unnamed (y)	Yakima River	165	46				X						X	F
Reecer Creek (y)	Yakima River	166	46				X						X	D
Unnamed (y)		167	46				ND							F
Jones Creek (y)	Yakima River	168	46	X						X	X			D
Jones Creek (y)	Yakima River	169	46				X						X	F

TABLE 3 (CONTINUED)
PIPELINE WATERWAY CROSSINGS, FISHERIES UTILIZATION, SALMONID HABITAT, POTENTIAL IMPACT AREA, SENSITIVITY INDEX, AND PROPOSED CROSSING METHODS

Waterway(1)	Tributary To(2)	Crossing Number(3)	Atlas Page(4)	Fisheries Utilization(5)				Salmonid Habitat(6)			Sensitivity Index			Crossing Type(7)
				Sens/ Anad	Res Sal	Other	Unk	Summer	Winter	Spawn	High	Mod	Low	
Jones Creek (y)	Yakima River	170	47				X						X	F
Unnamed (y)	Pond	171	47				ND							F or DRY
Unnamed (y)		172	47				ND							F or DRY
Unnamed (y)		173	47				ND							F
North Branch Canal (n) (c)	Yakima River	174	47				X						X	B
Unnamed (u)		175	47				ND							F
Unnamed (n) (c)	Currier Creek	176	47				ND							F
Currier Creek (y)	Yakima River	177	47		X					X		X		F
Unnamed (y)	Currier Creek	178	47				ND							F
Unnamed (y)		179	48				ND							F
Currier Creek (y)	Yakima River	180	48				X						X	F
Unnamed (u)	Yakima River	181	48				X						X	F
Unnamed (n) (c)	Yakima River	182	48				X						X	F
Unnamed (n) (c)		183	49				ND							F
Unnamed (y)	Yakima River	184	49				X						X	F
Unnnamed (n) (c)	Yakima River	185	49				X						X	F
Unnamed (y)	Yakima River	186	49		X			X	X			X		F
Wilson Creek (y)	Yakima River	187	49		X			X				X		F

TABLE 3 (CONTINUED)
PIPELINE WATERWAY CROSSINGS, FISHERIES UTILIZATION, SALMONID HABITAT, POTENTIAL IMPACT AREA, SENSITIVITY INDEX, AND PROPOSED CROSSING METHODS

Waterway[1]	Tributary To[2]	Crossing Number[3]	Atlas Page[4]	Fisheries Utilization[5]				Salmonid Habitat[6]			Sensitivity Index			Crossing Type[7]
				Sens/ Anad	Res Sal	Other	Unk	Summer	Winter	Spawn	High	Mod	Low	
Canal (n) (c)		188	50				X						X	B
Canal (n) (c)		189	50				X						X	B
Naneum Creek (y)	Yakima River	190	50	X	X	X		X			X			F
Unnamed (y)		191	50				ND							Avoided
Unnamed (y)		192	50				ND							Avoided
Naneum Creek (y)	Yakima River	193	50				X						X	F
Cascade Canal (n) (c)		194	51				X						X	B
Unnamed (u)	Coleman Creek	195	51										X	F
Coleman Creek (y)	Yakima River	196	51	X	X			X			X			F
Unnamed (y)		197	51				ND							F
Canal (n) (c)		198	51				X						X	F or B or D
Cooke Creek (y)	Cherry Creek	199	52	X							X			F
Caribou Creek (y)	Cherry Creek	200	52		X			X				X		F
Parke (u)	Cherry Creek	201	52				X						X	F or DRY
Unnamed (u)		202	52				X						X	F
Cascade Canal (n) (c)		203	53				X						X	B
Unnamed (y)	Parke Creek	204	53		X			X					X	F
Parke Creek (y)	Cherry Creek	205	53		X			X				X		F

TABLE 3 (CONTINUED)
PIPELINE WATERWAY CROSSINGS, FISHERIES UTILIZATION, SALMONID HABITAT, POTENTIAL IMPACT AREA, SENSITIVITY INDEX, AND PROPOSED CROSSING METHODS

Waterway(1)	Tributary To(2)	Crossing Number(3)	Atlas Page(4)	Fisheries Utilization(5)				Salmonid Habitat(6)			Sensitivity Index			Crossing Type(7)
				Sens/ Anad	Res Sal	Other	Unk	Summer	Winter	Spawn	High	Mod	Low	
Parke Creek (y)	Cherry Creek	206	54				X						X	F
Highline Canal (n) (c)		207	55				X						X	B
Parke Creek (y)	Cherry Creek	208	55			X							X	F
Parke Creek (y)	Cherry Creek	209	55				X						X	F or DRY
Unnamed (u)	Parke Creek	210	55				ND							F or DRY
Parke Creek (y)	Cherry Creek	211	55				X						X	F or DRY
Unnamed (u)	Parke Creek	212	56				X						X	F or DRY
Unnamed (u)	Parke Creek	213	56				X						X	F or DRY
Unnamed (u)	Parke Creek	214	56				X						X	F or DRY
Unnamed (y)	Parke Creek	215	57				X						X	F or DRY
Columbia Basin														
Unnamed (u)	Sagebrush Spring	216	61				X						X	F or DRY
Unnamed (u)		217	61				X						X	F or DRY
Unnamed (u)		218	61				X						X	F or DRY
Unnamed (y)	Canyon Creek	219	63				ND							F or DRY
Middle Canyon Creek (y)	Johnson Creek	220	63				X						X	F or D
Middle Canyon Creek (y)	Johnson Creek	221	63				X						X	F or D
Johnson Creek (y)	Columbia River	222	63		X							X		F

TABLE 3 (CONTINUED)
PIPELINE WATERWAY CROSSINGS, FISHERIES UTILIZATION, SALMONID HABITAT, POTENTIAL IMPACT AREA, SENSITIVITY INDEX, AND PROPOSED CROSSING METHODS

Waterway[1]	Tributary To[2]	Crossing Number[3]	Atlas Page[4]	Fisheries Utilization[5]				Salmonid Habitat[6]			Sensitivity Index			Crossing Type[7]
				Sens/ Anad	Res Sal	Other	Unk	Summer	Winter	Spawn	High	Mod	Low	
Columbia River (y)	Pacific Ocean	223	64	X	X	X		X			X			HDD or BRIDGE
GRANT COUNTY														
Columbia Basin														
Unnamed (n) (d)		224	65				X						X	DRY
Unnamed (y)	CNWR	225	66				X						X	F
Unnamed (n) (w)	CNWR	226	67											WET
Unnamed (n) (w)	CNWR	227	67											WET
Unnamed (y)	CNWR	228	67			X							X	F
Unnamed (n) (d)		229	68				X						X	DRY
Unnamed (y)		230	69				X						X	F
Unnamed (y)		231	69				ND							F
Unnamed (n) (c)		232	69				ND							Avoided
Royal Branch Canal (n) (c)		233	69				X						X	B
Canal (n) (c)		234	69				X						X	B
Royal Branch Canal (n) (c)		235	70				X						X	B
Canal (n) (c)		236	71				X						X	B
Crab Creek Lateral (n) (c)		237	71				X						X	F or B or D
Unnamed (n) (d)	Lower Crab Creek	238	73				X						X	F or Dry

TABLE 3 (CONTINUED)
PIPELINE WATERWAY CROSSINGS, FISHERIES UTILIZATION, SALMONID HABITAT, POTENTIAL IMPACT AREA, SENSITIVITY INDEX, AND PROPOSED CROSSING METHODS

Waterway[1]	Tributary To[2]	Crossing Number[3]	Atlas Page[4]	Fisheries Utilization[5]				Salmonid Habitat[6]			Sensitivity Index			Crossing Type[7]
				Sens/ Anad	Res Sal	Other	Unk	Summer	Winter	Spawn	High	Mod	Low	
Unnamed (y)	Lower Crab Creek	239	74				X						X	F
Unnamed (n) (c)	Lower Crab Creek	240	75				X						X	F
Canal (n) (c)		241	75				X						X	F or B or D
Canal (n) (c)		242	76				X						X	F or B or D
Unnamed (n) (c)	Lower Crab Creek	243	77				X						X	F or D
Lower Crab Creek (y)	Columbia River	244	77		X	X		X				X		D
Unnamed (y)		245	77				ND							F
Unnamed (y)	Lower Crab Creek	246	78			X							X	F
Unnamed (n) (d)		247	78				ND							Avoided
Unnamed (n) (d)		248	79				ND							Avoided
Unnamed (n) (d)		249	79				ND							Avoided
Unnamed (y)		250	79				X						X	Avoided
Unnamed (y)		251	80				X						X	Avoided
Unnamed (n) (d)		252	80				X						X	DRY
Unnamed (n) (d)		253	80				X						X	DRY
Unnamed (n) (d)		254	80				X						X	DRY
ADAMS COUNTY														
Columbia Basin														

TABLE 3 (CONTINUED)
PIPELINE WATERWAY CROSSINGS, FISHERIES UTILIZATION, SALMONID HABITAT, POTENTIAL IMPACT AREA, SENSITIVITY INDEX, AND PROPOSED CROSSING METHODS

Waterway[1]	Tributary To[2]	Crossing Number[3]	Atlas Page[4]	Fisheries Utilization[5]				Salmonid Habitat[6]			Sensitivity Index			Crossing Type[7]
				Sens/ Anad	Res Sal	Other	Unk	Summer	Winter	Spawn	High	Mod	Low	
Canal (n) (c)		255	82				X						X	B
Canal (n) (c)		256	82				X						X	B
FRANKLIN COUNTY														
Columbia Basin														
Canal (n) (c)		257	83				X						X	B
Wahluke Branch Canal (n) (c)		258	84				X						X	B
Unnamed (n) (c)		259	85				ND							F or DRY
Canal (n) (c)		260	85				X						X	B
Canal (n) (c)		261	86				X						X	B
Unnamed (y)	Eagle Lake Wetland	262	87			X		X	X				X	F
Unnamed (y)		263	87				ND							F or OC
Canal (n) (c)		264	88				X						X	B
Canal (n) (c)		265	88				X						X	F or B
Canal (n) (c)		266	89				X						X	F or B
Canal (n) (c)		267	89				X						X	F or B
Unnamed (n) (c)		268	89											B
Canal (n) (c)		269	89				X						X	B
Potholes Canal (n) (c)		270	90				X						X	B

TABLE 3 (CONTINUED)
PIPELINE WATERWAY CROSSINGS, FISHERIES UTILIZATION, SALMONID HABITAT, POTENTIAL IMPACT AREA, SENSITIVITY INDEX, AND PROPOSED CROSSING METHODS

Waterway[1]	Tributary To[2]	Crossing Number[3]	Atlas Page[4]	Fisheries Utilization[5]				Salmonid Habitat[6]			Sensitivity Index			Crossing Type[7]
				Sens/ Anad	Res Sal	Other	Unk	Summer	Winter	Spawn	High	Mod	Low	
Canal (n) (c)		271	90				X						X	B
Canal (n) (c)		272	91				X						X	B
Canal (n) (c)		273	91				X						X	B
Eltopia Branch Canal (n) (c)		274	91				X						X	B
Canal (n) (c)		275	92				X						X	B
Canal (n) (c)		276	92				X						X	B
Canal (n) (c)		277	93				X						X	B
Canal (n) (c)		278	93				X						X	B
Canal (n) (c)		279	94				X						X	B
Canal (n) (c)		280	94			X							X	B
Canal (n) (c)		281	95				X						X	B
Canal (n) (c)		282	95				X						X	B
Esquatzel Diversion Canal (n) (c)		283	96				X						X	B
Esquatzel Coulee (y)		284	96			X							X	F
Canal (n) (c)		285	99				X						X	B

(1) Symbol (y) indicates that the waterway is under the jurisdiction of the Army Corps of Engineers (ACOE) pursuant to Section 404 of the Clean Water Act. Symbol (n) indicates that the waterway is not an ACOE jurisdictional stream. Symbol (u) indicates that the ACOE jurisdictionality of the waterway is unknown at this time, additional field surveys will be completed to determine ACOE jurisdictionality. Symbol (w) indicates that the waterway is actually a wetland at the pipeline crossing point. Symbol (d) indicates that at the pipeline crossing point there is no defined channel. Symbol (c) indicates that the waterway is an irrigation canal with little or no fisheries value.

(2) Tributary To. CNWR-Columbia National Wildlife Refuge.

TABLE 3 (CONTINUED)
PIPELINE WATERWAY CROSSINGS, FISHERIES UTILIZATION, SALMONID HABITAT, POTENTIAL IMPACT AREA, SENSITIVITY INDEX, AND PROPOSED CROSSING METHODS

(3) Dames and Moore's waterway crossing number. Crossing number increases as you follow the pipeline west to east.
(4) Map Atlas (see Dames & Moore, 1996a) page number for the waterway crossing.
(5) Fisheries utilization. Data taken from Washington Rivers Information System (WARIS) (WDFW, 1995a) and field surveys.: SEN/ANAD-sensitive or anadromous fish; RES SAL-resident salmonids; OTHER-other fish species; UNK-fisheries utilization is unknown because there is no information in databases. Waterway crossing was surveyed and Potential Impacts and Sensitivity Index was determined. "ND" indicates that there is no database information and the waterway was not surveyed.
(6) Salmonid habitat types present at specific or general pipeline crossing locations.
(7) Crossing types: HDD - Horizontal Directional Drill; F - Flume; D - Divert; DRY - Dry Trough; WET - Wet Trough; B - Bore; BRIDGE - Bridge; OC - Over Culvert; UC - Under Culvert.

The pipeline construction methods to be used for this project are standardized techniques. The methods and mitigation measures for this project are similar to the guidelines established at a national workshop to develop guidelines for the design and construction of pipeline waterway crossings (Tera Environmental Consultants and Beak Consultants, 1993). The standard methods proposed were designed to first avoid, and then minimize, environmental impacts. Open cut trenching is proposed for crossing most streams because overall there would be minimal impacts and it is the least expensive construction method. For streams that have significant fishery resources or environmental impacts, more expensive construction techniques (i.e., directional drilling) are proposed to avoid impacts. Where the potential environmental impact appeared to be the same with two crossing techniques, the less expensive method was chosen.

3.1.1 Open Cut Trenching

Most of the project streams would be crossed by open-cut trenching. This crossing procedure was selected because it is a traditional pipeline construction technique, and the cheapest method. All trenching, and other construction activities, would occur during construction windows that have been established by WDFW to protect salmonids. The general construction windows are specified by county, with some special construction timing considerations for important project streams. The general construction windows are listed below:

County	Construction Window
King	June 15 - October 15
Snohomish	June 15 - September 30
Kittitas	June 15 - September 30
Grant	July 1 - September 30
Franklin	July 1 - September 30
Adams	July 1 - September 30

Special Timing Requirements

Bear Creek	June 15 - September 30
Columbia R.	October 16 - March 31

Open-cut trenching is the preferred method for installing pipeline and crossing streams. When utilized, it can be very cost-effective and allow better control of some potential construction impacts than drilling or jack/bore methods. Where streambanks are steep, heavily wooded, or inaccessible from roads, the environmental impacts of open cut crossing can be less than those of directional drilling due to the need to get equipment (several trucks) to the drilling site. In established rights of way, open cuts will have minimal clearing of large trees. Crossings only take a few days or less to finish and sedimentation impacts will be brief. Short-term turbidity increases will be minimal in project streams with rocky bottoms. Trenching would generally be completed with the use of water diversions to prevent erosion and sedimentation through the use of diversion flumes and coffer dams. The pipes which are installed in and adjacent to the open cuts will be coated with concrete to provide negative buoyancy and additional mechanical strength.

The fisheries habitat at the pipeline crossings would be temporarily eliminated by open cut trenching. For construction, a trenching machine would work across the active stream channel perpendicular to streamflow. The process would disturb an area approximately 30' wide. In riffle areas, or crossings with mostly spawning gravel, the impacts would be minimal. After excavation, the trench would be filled with suitable new spawning gravel and the habitat would be enhanced. For streams that have summer or winter rearing habitat, the streambed would be re-contoured to match preconstruction conditions. However, even with contouring efforts some of the habitat value would be temporarily lost. The rearing habitat and the hydraulic conditions at the crossings would be disturbed. It could take two years (or a bank full flow event) to redistribute the streambed gravels and cover and form new habitat elements that are usable by fish.

3.1.2 Boring

Boring will be used on a few waterway crossings, primarily the lined irrigation canals/ditches along the eastern part of the pipeline route. The method requires a starting and ending pit. The pits are excavated to a desired depth that will allow horizontal movement of the pipe under the canal. No instream habitat would be affected by boring activities. If riparian vegetation occurs adjacent to the canals and near the pit sites, the areas would be cleared of all vegetation. The clearing areas would be approximately 20 by 50'. Some of the advantages of guided boring over directional drilling include lower installation costs and no drilling muds to disperse. Also, most canal banks are higher than the surrounding land. For those waterways, there is a low potential for sediment to enter the canal during, or after, construction.

3.1.3 Directional Drilling

Directional drilling would occur under the Columbia River and will only affect vegetation well away from the active stream channel. Each starting and ending pad will require the removal of a minimum of approximately 1.5 acres of upland vegetation. The working areas around the pad will also be at least 200 by 250' for the starting pad and 100 by 200' around the ending pad. Drilling muds from the pilot hole and the reamed hole will also be collected at the starting and ending areas and spread over appropriate upland areas.

The other potential environmental impacts from directional drilling involve direct sedimentation. Rarely, the drilling activity "fractures" the substrate in the stream channel. Fine sediment from the drilling mud could leach into the active channel and be carried downstream by streamflow. This fine material could settle in low gradient depositional reaches and degrade spawning and rearing habitat. To minimize the potential for fracturing, the drilling will be well below the stream channels (see Section 2.14 Construction

Methodology of the EFSEC Application).

3.1.4 Utilization of Bridges

Four stream crossings currently have bridges that will be used for the pipeline. Impacts to the stream habitat and fisheries resources at these locations will be minimal because construction pits or pads would not be created. Existing riparian vegetation would be removed up to the bridges (30' wide on both streambanks) and no in-channel impacts would occur.

3.2 TYPES OF AQUATIC HABITAT IMPACTS

3.2.1 Physical Disturbance of Instream Habitat

The fisheries habitat at the pipeline crossings would be temporarily eliminated by open cut trenching. For construction, a trenching machine would cross the active stream channel perpendicular to streamflow. Construction activities would disturb an area approximately 30' wide. In riffle areas, or crossings with mostly spawning gravel, the impacts would be minimal. After excavation, the trench would be filled with suitable new spawning gravel and the habitat would be enhanced. For streams that have summer or winter rearing habitat, the streambed would be re-contoured to match preconstruction conditions. However, even with contouring efforts some of the habitat value would be temporarily lost.

The impacts to instream habitat from open-cut trenching would be temporary. Spawning habitat would be returned to its original condition, or improved, immediately after construction activities. There also will be short-term project impacts to the rearing habitat at the crossing sites. The rearing habitat and the hydraulic conditions at the crossings would be disturbed for approximately two years after construction. It would take a bank full flow event to redistribute the streambed gravels and form new habitat elements that are usable by fish.

3.2.2 Deterioration of Water Quality

The construction, operation, and maintenance of the pipeline may affect the aquatic habitat. The turbidity of the streams may increase due to physical habitat disturbance during construction, and from unstable streambanks. The potential water quality impacts resulting from hydrostatic test water discharges, bentonite seepage at drilled crossings, and hazardous material spills are addressed in the EFSEC Application Sections 2.5, 2.7, 2.9, and 7.2 (Dames & Moore, 1996a).

Sedimentation

If not mitigated, adverse impacts from suspended sediments could include but are not limited to:

- Fish mortality or injury due to damaged gill tissues. This may lead to asphyxiation or increased susceptibility to disease.
- Reduced fish feeding efficiency. Reduced visibility due to water turbidity could impact feeding efficiency.
- Destruction of food production areas. The stream substrate could fill with fine sediment.
- Mortality of aquatic invertebrates and their habitat.
- Reduced spawning success. Filling of spawning gravel could "armor" spawning substrates and reduce or eliminate spawning activity.
- Mortality of eggs, fry, and juvenile fish. Gravels impacted with fine sediment would have reduced streamflow and oxygen. Emerging fish could be trapped by fine sediment in the gravel interstices.
- Reduction of available summer rearing and winter holding habitat for fish.
- Delay migration of adult spawners.

Sedimentation may occur during and after pipeline construction activities are completed. Sediment released at the waterway crossing sites may affect various types of instream habitat, especially spawning habitat in low gradient areas downstream of the crossings. Potential sources of sediment include the stream channel that is disturbed for trenching and the exposed streambanks that have been stripped of vegetation. Sedimentation impacts would be temporary. A small amount of sediment would be released immediately from the channels that will be trenched. Bare streambanks could also release sediments until the crossing s have been completely revegetated. Those impacts would be short-term, and banks should be stabilized within five years of construction. The potential downstream impacts of sedimentation based on stream hydrological and fisheries information, and the appropriate mitigation measures, are summarized in the Water Technical Report (Dames & Moore, 1996b). Sedimentation impacts to fishery resources near the crossing locations are addressed in this report (Section 3.3 and Table 3) and in Sections 2.10 and 2.14 of the EFSEC Application (Dames & Moore, 1996a).

Mitigation measures to address those impacts are described in Sections 2.10 and 3.3 of the EFSEC Application have been included to avoid or minimize the potential effects on aquatic resources that are related to sediment input and sediment deposition in the immediate vicinity of the construction sites. Because of the mitigation measures, sediment carried along by streamflow is expected to have no or minor effects on aquatic organisms, depending on the quantity of material and the duration of suspended sediment exposure.

3.2.3 Removal of Vegetation

The removal of riparian vegetation for any type stream crossing will result in short-term impacts to the fisheries resources. Thirty lineal feet of both streambanks will have all vegetation removed during construction activities. Overhead cover for fish would be removed for some streams. The permanent construction impact will be the removal of large trees at the crossing locations. These trees will not be replanted in the pipeline right-of-way because the corridor will have to remain visible from the air during future inspection flights. The streambanks would be revegetated with just shrubs (willows). The removal of trees adjacent to the streams may result in a minor increase in local runoff because precipitation interception would be reduced. This may cause a small increase in erosion, turbidity, and suspended solids in the streams. Until the banks are revegetated (within 5 years), the exposed streambanks would also be susceptible to erosion and sedimentation of the habitat could occur. The loss of streambank vegetation, large woody debris, and other instream cover will also result in a temporary decrease in fish cover.

The removal of streamside vegetation could slightly increase the water temperature at the stream crossing sites by reducing the shading. This potential impact is important for streams that have summer rearing habitat for fish, especially those in Eastern Washington. However, it is not expected that water temperatures would change significantly. Many project streams have already been affected by construction activities (roads, bridges, culverts, railroad, and transmission lines) at the proposed crossing sites and their riparian areas are not intact. A relatively small lineal distance of streambank will be affected at each stream crossing and there would be insignificant impacts due to temperature increases.

3.2.4 Acoustic Shock

While highly unlikely, it is possible that some stream crossings may require blasting of bedrock. Blasting can be harmful or fatal to fish due to acoustic shock or damage to their air bladders. Laterally compressed fish (i.e., largemouth bass) are the most sensitive to blast related acoustic shock, while the more fusiform body types (i.e., trout and salmon) are the least affected. Effects of these explosions will be mitigated by several factors. Active construction in the stream will probably scare most fish out of the construction areas prior to detonation. A small scare charge or air bubble curtains will also be used to minimize this impact. Fish will also be collected within the area of blasting and held until construction is complete then released to the same general area. The area will be netted off to avoid migration of other fish into the area during construction. Most blasting and construction activities should occur during low flow periods, because it would be difficult to maintain instream nets.

3.3 ESTIMATES OF IMPACTED HABITAT

The amount of impacted aquatic habitat is directly correlated to the types of crossing methods and other environmental variables. The majority of the streams will be trenched and the amount of impacted habitat is in Table 3. Some waterways will not have impacted aquatic habitat. They have deep road fills above culverts that can be trenched without disturbing the stream channel. Other waterways will be crossed by bridges, or the pipeline will be drilled under the stream channel. Refer to the impacts column and the legend for Table 3 for each waterway.

We did not estimate the amount of impacted habitat for 103 waterway crossings identified from Data96. None of them have been classified by DNR and they probably do not support fish based on their size and pipeline crossing location. They could, however, be important contributors of high-quality water to downstream reaches. All of these waterways, except one, are first and second order streams and they probably have very small channels. The pipeline would cross them near their headwaters in most cases.Even though these waterways have not been inventoried, it is apparent from the Map Atlas (Dames & Moore, 1996) that some of these channels could be dry or have intermittent flow for most of the year. Several of the channels do not appear to drain into another stream or waterbody. The overall sensitivity of these crossings and potential mitigation measures are presented in the Water Technical Report (Dames & Moore, 1996b).

For boring and directional drilling crossings, none of the aquatic habitat in the active channel will be disturbed when placing the pipeline under the stream. Only working areas around the pits or pads and the streambanks will be cleared of vegetation, which would affect primarily overhead cover for fish. These impacts to vegetation are noted in the Section 3.4.2.2 of the EFSEC Application.

The pipeline will be suspended on existing bridges for several stream crossings. There will be no channel impacts at those locations. Vegetation adjacent to the stream channel may be impacted and those impacts are noted in Section 3.4.2.2 of the EFSEC Application.

The majority of the streams will be crossed by open-cut trenching. The trenching machine will disturb an area approximately 30' wide or less across the channel. To determine the total surface area of the active channel that may be disturbed for each stream crossing, the average bankfull width of the stream was multiplied by the construction corridor width. These estimates are very conservative since bankfull width is only realized approximately every 2 years, and the area of wetted channel is usually less. The estimates of potential impact do not include the riparian zone area that may be disturbed during construction.

3.3.1 Stream Sensitivity Index

To simplify the discussion of the potential fisheries impacts from the project, each stream and its crossing method was considered. A qualitative stream sensitivity index was developed which considers the fish habitat at the crossing and downstream area that may be affected, and the fish utilization of that habitat. The index ratings (high, moderate, and low) for each stream or a group of streams were developed based on several variables. First, the current fisheries utilization of the streams, with emphasis on the general stream crossing area, was used to group the project streams. The utilization data were from WARIS (WDFW, 1995) and field observations. The following fisheries utilization variables were considered (listed in order of importance):

1. Utilization by sensitive fish species (federal and state candidate species) or anadromous fish species

2. Utilization by resident salmonids

3. Utilization by other fish species

4. No fisheries utilization or values, or utilization is unknown

After the initial grouping, the width of the proposed stream crossing was considered to determine the exact crossing method. Various types of fisheries habitat (summer rearing, spawning, winter) could be impacted for each stream, depending on existing conditions and the crossing method chosen. Refer to Table 3 for the project streams and the fish habitat types present at the crossing locations.

The project streams that support sensitive and/or anadromous fish at the pipeline crossing locations received a "high" stream sensitivity index rating. A moderate rating was given to the smaller streams that supported resident salmonids or to streams that have a variety of habitat types and are assumed to support salmonids. The "low" rating was assigned to small streams with other fisheries values, or those creeks that had limited/no fisheries values or fisheries utilization is unknown.

There are three large stream crossings that have a "high" sensitivity rating. They include Snoqualmie River (lower crossing), Yakima River, and the Columbia River. These very large rivers are migration corridors for significant anadromous fishery resources. The Snoqualmie and Columbia Rivers will be crossed by directional drilling and there would be no sedimentation and direct disturbance of instream habitat. The Yakima River would be diverted and open cut trenched. The proposed crossing site is in an important spawning area for chinook salmon. A narrow bank of chinook spawning habitat would be temporarily impacted from construction activities. The condition of the spawning habitat should return to pre-project conditions in approximately two years.

There are also several smaller project streams that have a "high" rating. These are mostly tributaries to the Snoqualmie and Yakima rivers. The streams, at the crossing sites, can have a variety of habitat types that are important to anadromous salmonids.

Many of the project streams have a "moderate" sensitivity rating. These are smaller streams that support resident salmonids. The construction impacts to some of these streams will be avoided by using existing bridges and fill above culverts for placement of the pipeline. Most of these streams, however, will be crossed by open cut trenching.

There would be little fisheries impacts of construction for the streams with a low rating. Many of the streams at the crossing site have little or no fisheries values. Many were dry during the surveys and construction impacts will be minimal.

The stream sensitivity information is used in the Water Technical Report (Dames & Moore, 1996). The overall "channel sensitivity" to pipeline construction, operation, and maintenance is calculated for every project stream. The mitigation measures in that report were developed considering the waterway sensitivity to perturbation and the vulnerability of aquatic resources.

3.3.2 Impacts to Threatened or Endangered Species

There are no federal or state listed threatened or endangered species that utilize the streams, rivers, and canals of the project area. Species of concern may be present in some project waterways crossed by the pipeline (see Section 2.1). The occurrence of sensitive species is noted in Table 3.

4.0 MITIGATION MEASURES

Potential impacts to aquatic resources would be limited to the construction phase of the project. As such, the following mitigation measures pertain to construction. Because only selected trees will be removed from riparian areas, no other mitigation measures are proposed.

4.1 GENERAL CONSTRUCTION PROCEDURES

- The WDFW will be notified at least 48 hours prior to the commencement of pipe installation activities or blasting within each water body.

4.2 EROSION CONTROL

- Construction of stream crossings will be limited, to the extent feasible, to the low flow period, which on sensitive crossings will occur between approximately June 15 and September 15, to minimize sedimentation and turbidity induced by high water flow.
- Erosion control measures will be used while constructing pipeline trenches and staging areas, particularly erosion that could lead to increased sediment loads or turbidity in nearby waterbodies. The specific methods used will depend on site conditions such as slope, soil type, and downstream receptors.
- Temporary and permanent runoff diversion structures will be utilized after careful placement planning. Prompt grading, mulching, armoring, and revegetation will be used to minimize erosion. Sediment retention ponds will be used where sediment-laden runoff is greater than the capacity that can be controlled by more traditional means (i.e., straw bales and silt fences).

- Stable road fill will be used to minimize erosion.

4.3 REFUELING OF EQUIPMENT

- All construction equipment will be refueled at least 100' from water bodies.
- Equipment refueling or repair will not be allowed in or near the floodplain without adequate provisions to prevent the escape of petroleum products.
- Storing hazardous materials, chemicals, fuels, and lubricating oils, activities will be performed outside the floodplain (at least 100' from bank).
- Waste lubricants and solids will be removed from construction sites and be disposed of using Department of Ecology and EPA-approved procedures.

4.4 STREAM CROSSINGS

- The timing of all construction timing will consider the migrational periods and rearing conditions of the salmonids. The construction windows establish by WDFW for each county, or special project stream, will be followed.
- Where feasible, the pipeline will be attached to existing bridges at crossing sites to avoid impacts.
- The use of riprap will be minimized to areas where flow conditions preempt vegetative stabilization.
- EFSEC and WDFW will be notified at least 48 hours prior to proposed construction activities within streambeds.
- Crossings will be constructed perpendicular to the axis of the stream channel as engineering and routing conditions permit.
- Downstream flow rates will be maintained at all times.
- Equipment pads, clean rockfill and culverts, or a portable bridge will be used for equipment crossing sensitive perennial streams.
- Instream construction in minor streams will be completed within 24 hours.
- Sediment filter devices will be installed and maintained at all streambanks. The devices will be inspected on a daily basis and repaired as needed.
- Resident fish will be removed from stream crossing areas when blasting is necessary.
- Where possible, existing culverts will not be disturbed. The pipeline will be placed in fill above existing culverts to prevent construction impacts.
- Appropriate culvert sizing, placement and installation as determined by site specific hydrology will ensure proper drainage regimes and that fish passage is maintained.

4.5 HYDROSTATIC TESTING

- The entire pipeline will be hydrostatically tested in accordance with DOT regulations and in compliance with the stipulations of EFSEC regulations regarding water withdrawal and discharge. Pipe installed in rivers will be hydrostatically tested prior to installation. If leaks are detected, they will be repaired or the pipeline section replaced and the section retested.
- All welds to be installed under water bodies or wetlands will receive a 100 percent radiographic inspection.
- At least thirty (30) days prior to use, EFSEC will be provided with a list of specific locations for withdrawals and discharge of hydrostatic test water.
- EFSEC will be notified of the intent to begin using specific sources at least 48 hours prior to testing.
- The intake hose for the hydrostatic test water will be screened (1/8" mesh) to prevent entrainment of fish. The maximum approach velocity will not exceed 12 cm per second.
- Adequate flow rates will be maintained at all times to protect aquatic life and to provide for all other water body uses, including downstream withdrawals.
- When hydrostatic testing is complete, the test water will be analyzed and treated if necessary to make it suitable for discharge in compliance with the water withdrawal and discharge permits issued for the project.
- The water will be detained in ponds or holding areas and discharged to the ground or through filtering media before it enters any watercourse. Erosion protection measures will be incorporated into the water discharge procedures. Final discharge plans will be developed in consultation with EFSEC.
- The water discharge rate will be regulated and energy dissipation devices will be used in order to prevent erosion of upland areas, stream bottom scour, suspension of sediments, or excessive stream flow.

4.6 CLEARING, RESTORATION, STABILIZATION, AND REVEGETATION

- All staging areas, access roads, and temporary roads will be located at least 50’ back from the streambank where topographic conditions permit to reduce loss of riparian vegetation and limit the probability that these additional cleared areas will erode.
- Clearing for staging areas for pipeline construction will be confined to the minimum area necessary.
- All spoil material from water body crossings will be placed in the right-of-way at least 10’ away from the riparian zone, or in other EFSEC-approved trenched material storage areas. All sediment will be contained within sediment filter devices.
- Disposal sites that contain cleared slash and overburden will be located in upland areas away from water bodies and will entail the use of runoff control structures.
- Streambanks will be stabilized prior to and after construction by replanting riparian

vegetation.

- Clean gravel will be used for the upper one foot of fill over trenches (excavations) in streams.
- Streambanks and channels will be returned to original contour where possible.
- Revegetation will be performed immediately after construction using vegetation that is quickly established and native trees for long-term stabilization.
- Log deflectors will be used that create sediment deposition and vegetation establishment to stabilize banks where possible.

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